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REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., September 14, 1922.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1922.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

ORGANIZATION OF THE BUREAU.

The Biological Survey deals with the conservation and increase of game, fur-bearing animals, and birds, and with the control of bird and mammal pests. Recent investigations reveal the fact that in the aggregate wild life resources, capitalized on the basis of a 6 per cent annual income, represent an enormous sum, possibly exceeding $1,000,000,000, and through intelligent management are capable of a great increase. On the other hand, certain forms of wild life, as the stock-killing wolves and other predatory species, with many rodents, as the house rat, prairie dog, and others, annually destroy forage crops and other property exceeding $500,000,000 in value, a loss which may be largely prevented by properly directed efforts. For the purpose of handling the considerable number and variety of problems involved in such activities the bureau is organized as follows:

1. Economic investigations, Dr. A. K. Fisher in charge. This division handles the necessary investigations of injurious mammals and provides the organization and leadership of campaigns for the destruction of predatory animals and injurious rodents throughout the country. It also maintains an experimental fur farm and investigates all matters related to fur farming for the benefit of this new industry.

2. Food habits research, W. L. McAtee in charge. By authority of the Secretary, investigations of the economic relations of birds, reptiles, and amphibians were separated from the division of economic investigations in July, 1921, and made a separate division as indicated.

3. Biological investigations, E. A. Goldman in charge. Under this division investigations are made of the distribution, migration, and other habits of birds and wild animals, and of the distribution of plants and of wild life in relation to climate for the purpose

of mapping the life zones of North America. Technical laboratory studies also are made of both birds and mammals, these activities providing the basic scientific information needed in connection with the rapidly growing economic work of the bureau. Scientific information is supplied on request to other governmental departments, State organizations, and individuals.

4. Alaska reindeer and fur bearers, E. W. Nelson and W. F. Bancroft in charge. Investigations are made of the diseases and parasites of reindeer, together with grazing and herd management and breeding experiments on the mainland and in the Aleutian Islands; also through a warden service laws are enforced for the protection of the land fur-bearing animals of Alaska; and islands are leased for fur farming, and investigations made for the upbuilding of the fur-farming industry in the Territory.

5. Game and bird reservations, H. F. Stone in charge. This division covers work connected with the maintenance and supervision of a warden service on the larger reservations, building and upkeep of game-proof fences and wardens' quarters, posting of boundaries, and hay farming and feeding of elk on a large scale at the winter elk refuge.

6. Migratory-bird treaty and Lacey Acts, G. A. Lawyer in charge. Activities under this division cover the maintenance and supervision of a warden service throughout the United States and in Alaska for the enforcement of the migratory-bird treaty and Lacey Acts, the former protecting birds migrating between the United States and Canada and the latter dealing with unlawful interstate commerce in game and the supervision of importations of living foreign birds and mammals to prevent the introduction of harmful species.

ECONOMIC INVESTIGATIONS.

The establishment during October, 1921, of a well-equipped laboratory at Denver, Colo., for investigating poisons and their preparation and use will be an important factor in increasing the effectiveness of campaigns for the destruction of predatory animals and harmful rodents. Necessary machinery has been installed in the laboratory to process or otherwise prepare all the poison needed by field parties of the bureau and cooperators throughout the country. During the year the processed strychnine prepared amounted to more than 10,000 ounces. Investigations in the use of poisons have already resulted in greatly increased effectiveness and lowered cost of operations.

Appreciation of the practical value of the methods developed by the Biological Survey for the destruction of predatory animals and injurious rodents is shown indisputably by the continuance of substantial financial support from cooperating States, organizations, and individuals, amounting to $996,379 for the year. More than 105,000 men took part in the work, and from their reports it is estimated that a saving was made of crops and live stock amounting to more than $10,000,000.

The continuous campaigns against injurious animals are gradually eliminating large gray wolves over most of their former range and will gradually wear down the numbers of all predatory

species until losses from them will become comparatively small. The extermination of harmful rodents over vast areas is also only a matter of continued operations. Two counties in Arizona and four in Kansas have been completely freed from prairie dogs during the year and the numbers of rodents are being decreased year by year over a vast area.

Work at the experimental fur farm and other investigations of fur farming continue to yield information of the greatest practical value to this new and rapidly growing industry.

PREDATORY ANIMALS.

Establishment by the bureau of definite organizations in the Western States, upon which live-stock producers call for assistance in case of serious depredations by wolves, coyotes, and other animals, and through which definite information is available as a basis for carefully projected campaigns, is steadily reducing losses of live stock from this source, which, at the time the organized work was undertaken in 1915, were estimated at more than $20,000,000 annually. These organizations, in the grazing States of the West and also in Michigan, work in cooperation with State departments of agriculture, State live-stock commissions, State game commissions, county organizations, stockmen's associations, and individuals to clear predatory animals from great units of Federal, State, and private lands used for grazing. This is accomplished by means of carefully planned trapping, shooting, and den-hunting operations and by poisoning campaigns, which have been conducted on an unprecedented scale.

Trained hunters have also been stationed along passes leading across the Mexican border to capture promptly wolves and other predatory animals as they enter this country, and arrangements have been made with stockmen in northern Mexico for the maintenance of hunters who work in cooperation with the Federal and State forces of the United States along the international border. A constantly recurring invasion of wolves from Mexico into New Mexico and Arizona is being thus successfully controlled. Similar concerted action along adjacent State borders is very effective in destroying wide-ranging animals like wolves. Cooperation with other Federal agencies, as the Forest Service, of the Department of Agriculture, and the Office of Indian Affairs and the National Park Service, of the Department of the Interior, has also been obtained in this work.

During the year an average force of 266 hunters, trappers, and poisoners was employed under bureau supervision, and many thousands of stockmen participated in the distribution of poisoned baits during the organized drives. Part of the men employed were paid by the Federal Government and part by the States and other cooperating agencies, which contributed $196,405 to the work. Hunters are required to turn in as evidence the skins or scalps of animals killed when found in condition for the purpose. Such positive evidence was obtained during the year in the case of 30,986 predatory animals, of which 687 were large gray wolves, 27,185 coyotes, 2,827 bobcats and Canada lynxes, 173 mountain lions, and 114 bears. Bears are generally regarded as game animals and are protected by some

State laws, and no effort is made to take any except individuals known to be destructive to live stock.

In addition to the dead animals secured, it is estimated that not less than 50,000 coyotes were killed in connection with the extended poisoning operations, but their carcasses were not found. Many wolves, bobcats, and some mountain lions were also poisoned. Complete returns of animals killed in poisoning campaigns are not obtainable, but the marked reduction in the numbers of coyotes over the large areas poisoned and the number of carcasses found by stockmen on their ranches and by hunters about poison stations where it has been possible to make careful observation, indicate that this number is conservative.

The killing of about 80,000 predatory animals represents a saving of live stock and game for the year amounting to over $4,000,000 on the accepted basis of computation. Skins sold during this period yielded $34,202.75, of which $22,375 was derived from skins taken during this fiscal year, making a total revenue derived by the Government from this source in excess of $283,000 since 1915.

In the poisoning operations for the year, about 1,229,000 specially prepared and highly effective poisoned baits devised by bureau experts were used. Two methods of placing the poison are employed. Small fat baits, consisting of a small piece of meat or other substance attractive to coyotes, are placed on the ground about a poison station, or the baits are studded in carcasses of sheep, cattle, horses, burros, or other animals.

The chief poisoning operations are conducted in winter, but very effective work has been done in summer in desert country, particularly around watering places. The small fat baits distributed about a poison station are especially suited to operations over plains and deserts where the climate is at least moderately warm and natural food for predatory animals is abundant. Carcass poisoning is successful on the high summer ranges, where the weather in winter is colder and the natural food supply of predatory animals is scarce. The value of this method lies in its permanency, as the poison continues effective until spring or until no part of the animal remains; and it makes possible the destruction of predatory animals over vast timbered and mountainous areas where no camp accommodations are available during the winter months and travel is impossible except on snowshoes. The poison-studded stations are established after the sheep and cattle have been removed to lower ranges and when the weather is sufficiently cold, the hunters working down the mountains behind the retiring herds. As the stock is again moved up to the summer ranges in spring the hunters go in advance to destroy all the stations that were established, in order to prevent accidental poisoning of dogs or other animals and to trap any predatory animals which have escaped the poison. Similar systematic work on winter ranges and lambing grounds has practically ended livestock losses over great areas and has much reduced them at other places.

In a period of five weeks two Utah hunters put out a poison line approximately 300 miles long in a great loop and around their first two stations on their return found about 40 dead coyotes. A stockman wrote that these men did good work, for, as he put it, they left a string of dead coyotes wherever they went. In one locality, after

a poisoning campaign, men in charge of sheep herds reported finding, respectively, 14, more than 50, and 73 dead coyotes. The county agent at Prineville, Oreg., reported over 100 coyotes poisoned on the Ochoco National Forest in that locality, and 70 were found in the vicinity of Mitchell, on the east side of the forest.

In response to a telegram from stockmen using the range at the south end of the Whetstone Mountains, Ariz., stating that there were a number of wolves destroying cattle in that range, the district inspector went promptly into the locality and put out a line of poison on the designated range, which killed three wolves and several coyotes. A hunter left to complete the work succeeded in trapping the four wolves which remained on the range, thus cleaning out the entire pack of seven adult wolves in less than 30 days. This prompt and effective action was greatly appreciated by the stockmen. Two other wolf packs which had crossed from Mexico were cleaned up, making a total of 30 wolves destroyed along the international border without allowing a wolf to drift more than 25 miles into the United States, and only one to escape back into Mexico.

Another important catch was the "Pryor Creek Wolf," which had run for at least six years on the cattle ranges of Montana, where it was noted for its destruction of calves and Shetland ponies, its deeds of cunning, and its skill in eluding traps. Two Biological Survey hunters caught it within six days after their arrival on the range where it was operating.

South of Williams, Ariz., a large grizzly bear had been killing cattle each spring for the past 8 or 10 years. Stockmen had offered bounties ranging from $100 to $500 for its capture, and many private hunters and trappers had tried to earn them. It remained, however, for a hunter employed in the Federal-State cooperative work to kill this notorious animal as it was charging him after driving off his dogs. It was stopped by a well-placed shot when within about 15 feet of the hunter. The stockmen of that district estimated that during the past four years this bear had killed between $25,000 and $30,000 worth of live stock and probably more than twice that amount during its lifetime. This was one of the few remaining grizzlies in Arizona and by far the most destructive animal living in recent times on the ranges of that State.

Three wolves were killed in September south of Meeker, Colo., the old male having taken a serious toll from stockmen and terrorized this section for the past 15 years. Another male wolf, taken with his entire family near De Beque, Colo., had caused losses to stockmen in that vicinity amounting to many thousands of dollars, and was responsible during the last few months of its life for taking about 100 calves on one ranch, or two-thirds of the season's calf crop.

Notable progress has been made in the operations against mountain lions, which in many districts are so seriously destructive to colts as to make horse raising impracticable. They also make heavy inroads upon deer and other game. Lions have been so reduced in numbers along the Blue River, in the eastern part of Arizona, that few stock are found killed by them. It is reported that there are fewer lions along this river than at any time since white men have occupied the district, and that they are scarce along the north rim of the Grand Canyon, where formerly they were very numerous. Mountain lions have been hunted chiefly with dogs and rifle, but

encouraging success has been attained in poisoning operations, and they are occasionally trapped by using special scent baits attractive to them.

In Montana a hunter with his dog succeeded in killing five mountain lions between 1 and 4 p. m. on February 8 in one of the great deer yards, where the deer were found easy prey. During the period from November 26, 1921, to June 30, 1922, this hunter killed 23 lions, and another Montana hunter killed 14 during the year, one of them having been treed and shot just after killing a deer which it had not had time to eat.

PREDATORY ANIMALS AND GAME.

As the extent to which predatory animals destroy game becomes better known, State game departments are coming to cooperate more liberally with the bureau in efforts to destroy these animals. Their destructiveness is not only to such of the larger game as deer, elk, and antelope, but also to practically all of the ground-nesting species of game birds. In Michigan the work was initiated at the request of the conservation commission, primarily in the interest of game. The work in this State is being led by an expert of the bureau, and the field operations are financed by an increase of $1 on resident and $15 on nonresident deer-hunting licenses, which, with receipts derived from the sale of furs, skins, or live animals taken by hunters, yields sufficient revenue for very effective work, costing between $30,000 and $40,000 a year. Live-stock and agricultural interests profit by the Michigan plan, as instanced in certain cut-over forest areas, where sheep growing was found impracticable until the predatory animals were destroyed. It has been estimated after careful investigation that not less than 10,000 deer are killed annually by predatory animals in that State. Timber wolves, coyotes, wild cats, and foxes all join in game destruction, the kill being heaviest in winter, when the snow is deep, and especially in early spring, after the snow becomes crusted. At this period wolves and coyotes often appear to kill for no apparent reason other than for amusement or sheer lust of killing.

A good instance of the destructiveness of deer by wolves was observed by the bureau representative in southern Marquette County the latter part of March. Evidence had been found that a pack of wolves was working in the deer yards of that section, and one night they were heard howling. The following morning investigation was made on snowshoes and the tracks of a single wolf were soon located. The trail led a short distance to a swamp, where several deer were yarding over a small area and where the wolf was joined by two others and the round of destruction begun. The remains of four freshly killed deer were found on an area of about 3 acres. Subsequent investigations disclosed that in the few weeks preceding this time probably a hundred deer in yards scattered over an area of about 3 square miles in that locality were killed by these wolves. This number does not include many unborn fawns. The wolves also worked through other yarding sections, as they spent only a part of their time in the area described.

Coyotes destroy many deer in the forested sections, where two or three working together pull down the large animals whenever the

snow is deep or crusted, and appear to have much sport in doing it. Bobcats in the Upper Peninsula grow to a very large size, and the evidence is unmistakable in many cases that they kill young and even full-grown deer when the snow is deep. One hunter found three deer killed in deep snow during the early part of March by a single bobcat, which weighed 35 pounds and was trapped about the middle of the month at the carcasses.

Over some areas of the West where predatory animals have been largely eliminated there has been a notable increase in quail and grouse.

During the year organized predatory-animal field operations have been in progress in the following States: Arizona, Arkansas, California, Colorado, Idaho, Michigan, Montana, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. Demonstrations also have been made for stockmen in Missouri, Iowa, and Indiana, and information regarding the most effective methods of destroying predatory animals has been given to stockmen in Louisiana, Wisconsin, Minnesota, North Dakota, and other States where serious depredations were reported and application made for assistance for which no hunters were available.

The practice of examining and recording the stomach contents of predatory animals killed in field operations has given by far the most complete record in existence of their food habits and shows conclusively the destructiveness of these animals both to game and live stock.

RABIES.

The past year witnessed the most serious outbreak of rabies that has occurred since that of 1915 and 1916, when the disease was spread by coyotes and dogs through Washington, Oregon, Idaho, northern California, Nevada, and western Utah, causing great destruction of live stock and danger and loss of human life. The disease appeared in virulent form in Washington in the counties of Adams, Grant, Douglas, Franklin, Benton, Kittitas, and Lincoln, and was brought under control only after the adoption of most vigorous measures by the bureau's predatory-animal inspector in charge, cooperating with the State department of agriculture, the State and county health officers, and the State agricultural college. Quarantine measures were rigidly enforced, and the entire force of hunters which it was possible to maintain with regular and emergency appropriations made available for this purpose was concentrated in this region for the purpose of destroying the infected animals and possible carriers. About 1,800 coyotes were taken in five counties. As a result the epidemic was effectively controlled, but only after a considerable loss of live stock and much danger to the people of the locality.

Sporadic outbreaks of rabies also occurred among coyotes in Oregon, northern California, Nevada, and Utah. The disease made its appearance among dogs in Arizona and New Mexico, but its spread to coyotes of the locality was prevented by prompt inauguration of poisoning campaigns to destroy these animals in a wide zone surrounding the infected area. The regular recurrence of outbreaks of rabies and the serious consequences that would result should it again become widespread demonstrate the need of having experienced men ready to stamp out the disease whenever it makes its appearance.

RODENT PESTS.

Backed by the sustained interest and strong financial support of farmers and stockmen, the work of eradicating destructive rodents on Federal, State, and private lands has progressed with increased vigor. The concerted drives conducted under the leadership of bureau specialists have proved of such definite value that this advance has been made in spite of the general tendency toward retrenchment due to financial depression. In fact, it appears that this state of affairs has served to accentuate the importance of eliminating losses in production and waste of agricultural products due to rodent pests, since this has come in many places to be recognized as a factor which often determines profit or loss on the year's efforts. The correlation of Federal, State, and local agencies into an effective cooperating working force has been continued through the States Relations Service with the State extension organizations, including the county agricultural agents and State and county farm bureaus. State departments of agriculture have participated on an increased scale through the organization of pest districts and enforcement of State laws relative to clearing rodent-infested lands. Many other agricultural, horticultural, and live-stock organizations have also taken active part. Officials of the Forest Service and of the Office of Indian Affairs and the Reclamation Service continued to cooperate in campaigns involving Federal lands under their control.

Where features affecting community health were associated with the distinctly economic problems, as in bubonic and pneumonic plagues, Rocky Mountain spotted fever, and kindred disease-producing agencies disseminated by rodents, the bureau continued to cooperate with the United States Public Health Service, of the Treasury Department, and with State, county, and municipal health organizations. Such cooperation is essential to complete success when rodents infest both the cities and villages and the rural sections.

Conspicuous damage to crops and range grasses by the larger native rodents, as prairie dogs, ground squirrels, pocket gophers, and jack rabbits, first led to the large-scale organization of this work in the Western States. The marked benefits resulting from control measures employed against these rodents led to more careful and detailed observation and the recognition of the widespread and important damage by the numerous smaller but abundant native rodents.

PRAIRIE DOGS AND GROUND SQUIRRELS.

In the organized campaigns against prairie dogs and ground squirrels, 17,678,041 acres of Federal and private lands were given a first treatment with poisoned baits during the year, and follow-up work to complete eradication was done on 8,004,469 acres. This makes a total of 10,164,899 acres of Federal lands and 93,345,400 acres of State and private lands which have been treated since 1916 and largely cleared of these rodents in the following States: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming.

The bureau assumes the cost of operation on Federal lands, State officials on State lands, and farmers and stockmen on their own hold-

ings. Funds contributed by State and county appropriations and those expended by landowners in this cooperative undertaking during the year amounted to $799,974. Poisoned grain amounting to 1,008 tons was prepared and distributed under the direction and supervision of bureau representatives and 754,803 pounds of carbon bisulphide were used in fumigating burrows to complete the eradication of these rodents. Approximately 105,000 farmers and stockmen took active part in clearing their lands. Taking into consideration the low prices prevailing on farm and range products during the year, it is estimated that a saving of $6,000,000 was effected. The estimated annual saving of crops and range grasses since this work was instituted on a large scale in 1916 totals $60,000,000. As the lands are progressively and permanently cleared of these pests the savings effected by the annual campaigns become cumulative, permanent additions to the productiveness of the lands.

Field operations against prairie dogs and ground squirrels are being conducted with a view to the complete eradication of these rodents in a systematic manner over great units of land through such initial and follow-up measures as may be required. From 75 to 95 per cent of the animals are usually destroyed by the first poison treatment, and eradication is completed by later applications of poisoned grain and carbon bisulphide or other fumigating agents. Many counties throughout the West, previously heavily infested, have been thus cleared to a point where only an occasional animal can be found, while some counties report complete eradication of prairie dogs this year. The following extracts from a letter from a prominent stockman in Arizona indicate benefits accruing from this work:

> On June 25, 1922, the last prairie dog was exterminated from the counties of Cochise and Graham. This was the result of three years of united effort on the part of over 800 stockmen and farmers cooperating with two experts of the Biological Survey. An area 120 miles long and from 10 to 20 miles wide was actually cleared of this pest.
>
> Three years ago when I visited this district, I rode through miles and miles of prairie-dog infestation, and bare denuded lands lay on every side. To-day, after these pests have been exterminated, the grass is knee-high, fat stock and fertile farms are to be seen on every hand, and a prosperous community is in the making where heretofore at least 5,000,000 prairie dogs had their way and held in check the development of that fertile valley.
>
> It is estimated that the increased forage now made possible will support at least 50,000 head of sheep, and farmers are now growing alfalfa and grain on ground which was formerly so heavily infested with prairie dogs that it was quite impossible to raise anything.

As the county eradication campaigns reach a point where the few remaining rodents are no longer regarded as a menace there is often a tendency for landowners to slacken in the work. Definite effort is made by the bureau to have the work continued to complete extermination in order to insure against the rodents again reinfesting the lands. A number of counties which failed to push the follow-up work suffered considerable reinfestation and have now taken up the work in earnest with a view to being permanently rid of these destructive animals. The progress of the cooperative campaigns is seriously impeded, owing to insufficient Federal funds to clear Federal lands bordering private holdings. In many places this deters local activity, which would respond promptly but for the lack of money to enable the bureau to do its part.

POCKET GOPHERS.

Demonstration through field operations that the control of pocket gophers can be accomplished has led to increased demands for campaigns against them. Work has been undertaken on a large scale in Arizona, Idaho, Kansas, Nebraska, New Mexico, Oregon, Texas, and Washington, and considerable demonstration work also was done in Florida, Missouri, North Dakota, Oklahoma, and South Dakota. A determined effort is being made in alfalfa-producing sections to destroy these animals, which cause damage to this crop commonly amounting to $2 or more an acre and often destroy the entire stand. The mounds of dirt which they throw up also interfere seriously with the operation of harvesting machinery and assume great importance in irrigated lands, where intensive cultivation of root crops, orchards, and vineyards enables these animals to work havoc. As the damage occurs under ground, it is often irreparable before it is noticed. Only by knowing the possibility of injury on infested land and destroying the animals can this be avoided. Pocket gophers are being eradicated successfully through the employment of various vegetable, grain, alfalfa, or clover baits treated with strychnine and placed in the runways, and by the use of specially designed traps.

Producers of citrus fruits in the Salt River and Yuma Valleys of Arizona, where heavy losses were experienced, have been able completely to protect their orchards from pocket gophers by the methods employed in the campaigns inaugurated last year. It is estimated that over 1,200,000 of these rodents were killed in Arizona this year. In a recent contest, directed by the bureau representative, which took place in the Salt River Valley, Ariz., 1,135 schoolboys were provided with pocket-gopher traps and shown how to use them. By actual count they caught over 36,000 of these animals, the tails being retained as evidence. The winner caught 1,450. The contest cost $180 in prizes; but the county formerly paid 5 cents bounty on pocket gophers, so that $1,620 was saved the taxpayers on this drive alone, aside from the protection afforded the crops.

Pocket gophers are among the worst of our native rodent pests. Their destruction of crops and their burrows in irrigation canal banks, which cause serious washouts, build up an enormous annual loss to farmers. The work done in pocket-gopher control in Dona Ana County, N. Mex., last year, in which losses of this character, estimated at $60,000 a year, were eliminated at a total cost to the farmers of about $3,500, proved so successful that field operations have been extended to other portions of the Elephant Butte project, both in New Mexico and Texas, with a view to covering completely this important irrigation area. Approximately 140 miles of canal banks were treated with poison in 2 counties in Idaho, in conjunction with work done on farming lands in 11 counties of that State, where 79,000 acres of private lands were treated.

JACK RABBITS AND COTTONTAILS.

Particularly effective campaigns against jack rabbits were conducted in Idaho, Oregon, Washington, Nebraska, Utah, Arizona, and Texas under the favorable weather conditions which prevailed dur-

ing the past winter. Where these animals were proving seriously destructive to alfalfa, cotton, hay, muskmelon, lettuce, grain, and other crops they were killed in great numbers by means of organized drives and the use of traps and poison. In 10 counties of Idaho 32,235 pounds of bait treated with 2,159 ounces of strychnine were used on 312,350 acres of land. By poisoning and by drives, 640,050 jack rabbits, by actual count, were destroyed there. In 6 counties of Washington 155,500 jack rabbits were reported killed by poison, trap, and drive, 1,873 in one night by the use of 4 ounces of strychnine alkaloid dusted on 30 gallons of sliced apples. In Oregon it is estimated that 350,000 rabbits were killed in four counties where this work was undertaken, 58,300 being actually counted as a result of poisoning operations in the vicinity of Fort Rock. In three counties of Texas, 35,060 jack rabbits were killed by drives and the use of pens in which poisoned baits were placed after prebaiting at these places with alfalfa or maize heads to get the animals accustomed to feeding there.

Damage to orchards, vineyards, and agricultural crops by cottontail rabbits continued to be reported from many points throughout the country, and instructions for the control of these animals have been furnished.

MEADOW MICE, PINE MICE, POCKET MICE, AND KANGAROO RATS.

Although small in size, various kinds of native mice, under favorable conditions, become excessively abundant and do serious damage in orchards, gardens, and truck farms. During the year meadow mice appeared in destructive numbers in many of the important orchard sections of Idaho and Washington. Where this condition was foreseen in time, the use of poisons recommended by the bureau prevented serious damage, but in many localities where poisons were not used the loss of trees was heavy. Investigations made through the area infested by pine mice disclosed the fact that damage by these small underground animals was very great and widespread, irreparable injury to orchards often being done when the ground was covered with snow. Losses of sweet potatoes, white potatoes, and other root or tuber crops were also exceedingly heavy, and much damage to flower bulbs was reported. Pocket mice were found to be destroying as much as 3 bushels of grain an acre in two counties in the State of Washington. The damage was done by eating the planted grain and by cutting off the ripened heads at harvest time. Effective work was done by poisoning these mice where their abundance and destructiveness warranted.

Considerable assistance has been given landowners in the control of kangaroo rats, through demonstration of practical methods. Where these animals are found in large numbers, as in the sandy regions of the Southwest, they cut the grass and interfere materially with natural reseeding of the range by destroying great quantities of seed of the native forage grasses. Areas from 20 to 30 feet in diameter about their burrows are often completely denuded of grass, and where the rats are numerous they thus cause a reduction of 10 to 20 per cent in the carrying capacity of the range. They also make raids on fields of sprouting grain, thus reducing the amount and the value of the crop harvested.

WOODCHUCKS.

An unusually large number of complaints of excessive abundance of woodchucks and damage by them have been received during the year from points in the Eastern States. These animals also continued to be destructive in the Northwestern States to alfalfa and cultivated crops in the narrow valleys surrounded by rocky promontories amid which they live. One farmer writes that they entirely cleaned up 40 acres of wheat and 10 acres of alfalfa and took newly seeded corn out of 2 acres of ground. Demonstration of effective methods for destroying the animals has enabled landowners greatly to reduce losses. In one demonstration in which 1 ounce of strychnine alkaloid was used to poison green alfalfa tops 81 dead woodchucks were found.

HOUSE RATS AND MICE.

Information furnished by this bureau through bulletins and special articles on the destructiveness of house rats and mice, the danger to health involved in their presence, and practical methods for their control has been very widely used by magazines, farm journals, and newspapers, and by educational workers and public-spirited citizens in bringing the necessity for active control measures to the attention of individuals and communities. Public sentiment was developed until there is apparent an ever-increasing intolerance of the presence of these animals and the waste due to their depredations. The brown or house rat overshadows all other rodent pests as a waster of food and destroyer of property and as an agent in the dissemination of such serious communicable diseases as the bubonic and pneumonic plagues in man, trichinosis in swine, and avian tuberculosis in domestic poultry.

A survey made during the year of conditions of rat infestation in 27 States east of the Mississippi River showed that rats and their depredations were a problem common to all, complaint against them being as great in New England as in the Cotton Belt, and protests being equally numerous along the Atlantic seaboard and in the Corn Belt. Continual variations of the problem were encountered as specific instances of rat damage peculiar to individual localities were disclosed. Similar study of conditions in States west of the Mississippi River has shown the widespread and serious character of the rat problem in the Middle Western States and along the Pacific coast. Many local campaigns against rats have been waged throughout the country during the past year, and the bureau has responded to innumerable requests for information, for practical plans of organization, and for effective methods of combating these animals in concerted community efforts. Results thus far obtained emphasize the need of trained leaders in order to secure the proper coordination of local and State organizations, and the employment of methods best adapted to meet the varied situations presented. The bureau has endeavored, so far as practicable with available funds, to meet this need by assigning its specialists in rodent control to render this service to communities requesting help. Further educational effort is of the utmost importance to acquaint the public

more generally with the economic losses and menace to health due to the presence of rats and with effective methods of combating them.

In Utah the representative of the bureau cooperated with the extension service of the agricultural college and with the State superintendent of public instruction in presenting these matters effectively. A State committee was created to combine the efforts of all organizations into a State-wide movement, and similar committees were appointed in the public schools and school districts. Teachers in the schools made this a feature of their regular programs, specific phases of the matter being covered by the various subject groups, as classes in English, art, manual training, civics, biology, and hygiene. More than 125,000 people cooperated in the campaign, and there were distributed 15,000 Farmers' Bulletins on rats, 25,000 circulars giving directions for trapping, and 20,000 circulars containing specific instructions on methods of control; 6,000 students received special demonstrations, 37,000 posters were made in the schools, 30,000 essays were written on the subject, and 29,000 educational questionnaires were circulated; 1,250 pounds of barium carbonate were used in poisoned baits. Newspapers were liberal in giving the campaign publicity and in printing special articles on the subject of rat control.

A somewhat similar undertaking was launched in Iowa on request of interested citizens and organizations. An experienced representative of the bureau was detailed for a short time to work on educational material and outline methods adapted to conditions in this important agricultural State. The work was taken up actively by the extension service of the agricultural college, by newspapers of State-wide and local distribution, and by farm journals. The interest aroused by these efforts, both in Iowa and other States reached by the material issued, resulted in the destruction of great numbers of rats and the adoption of means for preventing rat infestation of farm buildings.

Special attention was given the requirements of poultry raisers in western Washington, both by means of demonstrations and by the issuance by the local bureau representative, through the State agricultural college and experiment station, of a circular prepared to meet the specific problems regarding rat control in poultry plants.

Investigations were conducted during the year for the purpose of improving procedure in combating rats by trapping, poisoning, rat-proof construction or repair of buildings, elimination of rat harborage, and the proper disposal of garbage and other sources of rat food. Special investigations were made regarding the effectiveness of the various rat viruses on the market and extensively advertised as a panacea for rat riddance. This work was carried on in cooperation with the experiment station of the North Dakota Agricultural College and with the Bureau of Animal Industry, of the Department of Agriculture. The experiment station published a circular setting forth the results obtained in the tests made at the station. All the results obtained in connection with these investigations and a large percentage of the reports from users of these products throughout the country indicate that such viruses are generally unreliable, and at their best the cost is out of all proportion to the destruction of rats that may be accomplished by their use.

MOLES.

Complaints concerning damage by moles in lawns, gardens, and truck farms have received attention, and much of the damage reported has been found to be due to mice following in the mole runways. This is generally the case where sprouting grain, vegetables, and flower bulbs are being eaten. Moles do real damage by lifting up the soil into ridges, so that grasses or other plants are killed by the breaking or drying out of the roots. This is the more common type of injury in the Eastern States. In western Washington and Oregon and in northwestern California, moles, in connection with their burrowing activities, also pile up mounds of dirt which cover and destroy crop or forage plants and interfere with the use of harvesting machinery. Where complaints of this kind were received, practical methods of control were supplied through correspondence, published material, or demonstrations.

PRODUCTION OF DOMESTIC RABBITS.

Considerable interest has continued in the production of domestic rabbits as a source of meat and fur. The bureau has kept in touch with leading rabbit producers and officials of National and State organizations of rabbit breeders. Information has been furnished regarding the care, feeding, and management of rabbits, and, in cooperation with the Bureau of Markets and Crop Estimates, regarding practical procedure in developing a market for the animals produced.

FUR-BEARING ANIMALS.

Important progress has been made in investigations pertaining to the rearing of wild fur-bearing animals in captivity. The rapid development within the United States of the industry of rearing silver, black, and cross foxes has necessitated efforts to work out practical methods for handling the problems constantly confronting the fur farmer regarding the health of the animals in captivity. During the year a large percentage of the fox farms in this country and Canada were visited by experienced representatives of the bureau for the purpose of studying practices of feeding and management employed and conditions affecting the health and fecundity of the animals, and of conferring with fox ranchers regarding problems requiring solution. Because of the great interest manifested in this work on the part of those engaged in the industry a bulletin is being prepared embodying an analysis of conditions found and suggestions for their improvement.

A questionnaire was sent out in the spring of 1922 to persons engaged in raising fur-bearing animals in the United States, in order to obtain comprehensive information regarding the extent of the industry, the success attained, and the capital invested. It has proved somewhat difficult to gather complete and authentic information, as some breeders appear to be suspicious or neglectful and fail to fill out and return the blanks.

The fur farms reporting were distributed through the following 25 States: California, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Hampshire, New Jersey, New York, North Dakota, Ohio,

Oregon, Pennsylvania, South Dakota, Texas, Vermont, Washington, and Wisconsin.

The imperfect returns furnish the following data regarding animals now being reared in captivity and the number of persons engaged in the business:

Fur animals.	Number of breeders.	Number of animals.	Fur animals.	Number of breeders.	Number of animals.
Foxes	231	6,702	Martens	6	74
Skunks	46	1,947	Muskrats	5	.....
Raccoons	27	131	Squirrels	3	86
Minks	19	170	Beavers	1	10
Opossums	8	86			

Judging from these figures and from observations made in the field by representatives of the Biological Survey, it is estimated that 500 ranchers are raising silver foxes in the United States; that they have between 12,000 and 15,000 foxes in captivity; and that the value of the investment is about $8,000,000.

Studies of fur bearers have been continued at the experimental fur farm at Keeseville, N. Y. The animals confined there are red and cross foxes, skunks, and martens. Experiments have been made in the feeding, housing, and management of these animals. The major part of the work, however, consisted of a study of the diseases and parasites which affect fur bearers and methods of control.

Progress was made in studies of the prevalence of internal and external parasites of foxes, in determining effective agents for their removal from infested animals, and in improving methods of administering remedies. Extended studies have been made regarding the tolerance of foxes to varied remedial drugs in order to determine safe and effective dosage at various ages and under varied states of health.

Examination of 446 fecal samples from 43 different fox ranches indicates that internal parasites are very prevalent. The most important parasites found are hookworms, roundworms, lung worms, flukes, tapeworms, and coccidia. Valuable information has been obtained regarding the occurrence of such parasites among wild foxes. Investigations of the relative susceptibility of fox pups at various ages to infestation with internal parasites, as compared with the adults, and of the seasonal variability in the abundance and the symptoms of parasitic infestation have yielded important information.

Studies have been continued of the physiology of foxes both in health and disease for the purpose of obtaining information regarding pulse, respiration, and temperature, and the variations of these at different ages and under differing conditions of excitement and health. Such information is required for a proper understanding of conditions existing in healthy animals and for the detection, diagnosis, and treatment of disease among them.

Experiments have been made regarding types of pens with improved sanitary features to ascertain their value in reducing disease, parasitic infestation, and mortality among young and adult foxes. Other experiments have been conducted to determine the effective-

ness of climatic agencies and the time interval required for these to destroy the eggs and larvae of parasites present in the pen soil. Results indicate that little reliance can be placed upon time to overcome infestation.

BREEDING SEASON OF THE MARTEN.

The discovery at the experimental fur farm that martens breed the last of July and in August has solved the problem which has heretofore prevented the successful rearing of these animals in captivity. The belief has been that these animals mate late in fall or in winter and that they could not be kept together during the summer season, and following this theory efforts to breed these animals in captivity have been unsuccessful. Martens have been bred on the experimental fur farm in August during the last three seasons and the period of gestation has proved to be about eight months. This discovery, together with the determination made regarding feeding and management, has made practicable the rearing of another of our valuable fur bearers in captivity.

FOOD HABITS RESEARCH.

The work of this division has centered about the relations of birds to agriculture, but progress was made also on an economic study of toads, and numerous stomachs of mammals were examined. During the year arrangements were made with three States for preserving the stomachs of animals killed as vermin by game wardens and employees of game farms. By means of this cooperation it is hoped to get a good basis of fact for discussion of the vexed vermin problem, consideration of which in the past has been based largely on conjecture and speculation.

A small auto truck and two motor cycles procured for field use have proved highly economical and effective aids to the work. The cost of operation has been surprisingly low, and the results show not only a very great economy over the use of common carriers but much more work accomplished, owing to the attendant freedom of action and elimination of delay.

CONTROL OF PINYON JAYS DAMAGING GRAIN IN COLORADO.

Pinyon jays, inhabiting the Rocky Mountain States, are birds of the same family as crows and about half their size. Between nesting seasons they rove in large flocks, sometimes containing thousands of birds, and wreak havoc on grain crops. Experiments in methods of control of these birds when attacking corn were entirely successful in west-central Colorado, and a leaflet containing directions for using a simple but effective poison formula has been distributed in that territory. Plans are being laid for studying the relations of the birds to wheat during the coming fiscal year.

BLACKBIRDS AND DUCKS IN RELATION TO GRAIN IN THE IMPERIAL VALLEY, CALIF.

Milo maize and barley, grain crops of the fertile Imperial Valley, Calif., attract immense flocks of blackbirds, which feed upon them throughout the fall and winter months. Investigation by a representative of the Biological Survey revealed an average destruction

of about 10 per cent of the crop over an area of 20,000 acres. This damage, together with lesser losses inflicted in adjoining areas, added to expenditures for protection of the grain, totals about $50,000 as the annual loss to the valley from blackbird depredations. An assistant experimented for several months with poisons, and, although occasional big kills were made, the results on the whole indicate that poisoning can not be depended upon for control. The possibility of employing toxic gases has been considered, but their practicability is doubtful. Meanwhile the expensive task of "bird-minding" is practiced, and while this alleviates the losses it is not an economical method of control.

Wild ducks, also, finding the irrigated fields of the Imperial Valley a tempting feeding ground, are especially destructive to newly sown barley and alfalfa. Examination of numerous stomachs showed that barley was the source of more than two-fifths of the food of pintails, about three-tenths of that of mallards, a fourth of that of widgeons, and a fifth of that of green-winged teal resorting to the barley fields. Three-tenths also of the food of the widgeon was alfalfa. Ducks cause damage not only by eating seed grain and alfalfa, but by their puddling method of feeding, which results in so compacting the soil that nothing will grow upon it until after it has been renewed by thorough cultivation. The ducks feed at night, and it has been found that operating automatic flash guns, together with firing blank shotgun cartridges, affords a considerable degree of protection to the crops.

WILD FOWL DESTRUCTIVE TO SHELLFISH IN MASSACHUSETTS.

Complaints that certain wild ducks destroy large numbers of commercially valuable shellfish in Massachusetts have been received from time to time, the season of greatest damage being alleged to be in midwinter, particularly during January, following the close of the shooting season. A representative of this bureau was detailed to make an investigation of the matter during the months of December, January, and February. All the important shellfishing grounds of the State were visited, testimony was taken, observations made, and specimens collected. Of the 11 species of wild fowl of which stomachs were collected, none had eaten a significant quantity of any commercial shellfish other than the common mussel and the scallop.

Since the mussel is so abundant everywhere and has only a limited sale, feeding of the birds upon it is of little consequence. The scallop, however, has an extensive market and usually brings a high price, the level of which is kept by the trade as near the maximum as possible. The inquiry as to damage to the shellfish industry, therefore, resolved itself into a study of the relations of wild fowl to a single species—the scallop. Of the 11 kinds of birds collected, 4—the murre, brant, red-breasted merganser or pheasant sheldrake, and the purple sandpiper or rock bird—had taken no scallops; and two others—the old squaw and whistler—made them only about 1 per cent of their food. Scallops composed 3.17 per cent of the food of 24 greater scaup ducks, 5 per cent of that of 44 eider ducks, 7.83 per cent of that of 12 black ducks, 20 per cent of that of 5 American scoters or butter-billed coots, and 44.43 per cent of that of 219 white-winged scoters or coots.

On account of the small proportion of scallops taken and the general habits of the species, it is not thought that the scaup, black duck, and eider are a menace to the scallop industry, nor have they been so accused. This reduces the problem to the status of the scoters, or coots, as enemies of scallops. Of the two species of these birds, the yellow-billed or butter-billed coot is not so hardy as the white-winged, and at the season damage to scallops is said to be the greatest—that is, the most severe part of the winter—comparatively few of this species are present. The white-winged scoter, however, is abundant, and at the season investigated makes almost half of its entire food of scallops. In the absence of any good done to offset this harm, the economic status of the white-winged scoter is bad, and what should be done about it is the problem.

Fishermen wish the open season extended so that they may shoot the birds, but it is inexpedient and impracticable to extend the season on a single species of duck. To extend the season on all species would be unwise, for most of the birds need all the protection they now receive. To shift the season to cover a later period conflicts with the interests and expressed desires of a large number of hunters of migratory wild fowl in Massachusetts. It would appear, however, that a remedy of this kind is unnecessary, since the scoters and other wild ducks are easily driven away from the scallop beds by running a boat near them. They feed on the beds only by day, and hence they can be rather easily controlled. It would seem that the scallop fishermen should be willing to undertake the small cost of patrolling the waters over the scallop beds from which their income is derived, but for the upkeep of which they are usually at no expense.

BIRDS INJURIOUS TO SMALL FRUITS.

Investigations of fruit-eating birds in Oregon, Washington, and Colorado were concluded early in the fiscal year. The birds involved in the Northwestern States were robins, band-tailed pigeons, purple finches, woodpeckers, and blue jays. The last-named birds are not protected by law, and permits have been issued when necessary for the destruction of robins and band-tailed pigeons. The other birds were not found seriously destructive. In Colorado also the robin was the species most injurious to small fruits, with magpies, band-tailed pigeons, woodpeckers, orioles, and tanagers of less importance. The magpie is not protected by law and robins may now be killed under permit. Modification of the protected status of the other birds concerned seemed unnecessary.

SURVEYS OF THE FEEDING GROUNDS OF WILD FOWL.

In continuation of the investigation of feeding grounds of wild fowl, work was begun among the very numerous and important lakes and marshes of Minnesota. Progress was made in the survey and information furnished to interested persons on the value in their natural condition of lakes involved in proposed drainage operations. Reports have been prepared on the previous seasons' surveys.

MISCELLANEOUS WORK IN ECONOMIC ORNITHOLOGY.

An assistant visited Fishers Island, N. Y., in September to observe the notable flights of hawks, to study the relation of these birds to a

pheasant farm there, and to collect specimens. The trip was moderately successful, but weather conditions were not propitious for the usual large flights.

In furtherance of a cooperative project with the Chemical Warfare Service, Edgewood Arsenal, Md., was visited for the purpose of planning equipment and procedure for an investigation of the possible usefulness of toxic gases in the control of injurious birds.

An illustrated lecture on "The value of birds to agriculture" supplied by the bureau to the States Relations Service at an earlier date for distribution was in good demand. During the latter half of the year 14 sets of slides were sent out, each accompanied by a copy of the lecture, several of them on circuits where they were in daily use for a month or more.

EXAMINATION OF STOMACHS OF BIRDS.

Work was continued on the English sparrow, the contents of about 800 stomachs being analyzed. Examinations of various groups of shorebirds were kept up to date, a considerable accumulation of material representing the various species of plovers was disposed of, and about 700 pellets of owls were examined.

Numerous special examinations of bird stomachs for correspondents were made, as in former years. Notable collections received in this way contained the stomachs of pileated woodpeckers, pigmy owls, and rough-legged hawks from Oregon; ruffed grouse from Wisconsin; great blue herons from Michigan; bobwhites from South Carolina; black swifts from Washington; and wild ducks from Peru.

WORK ON THE FOOD HABITS OF TOADS AND MAMMALS.

Nearly 600 stomachs of 3 species of toads were examined during the year. Toads are notable for taking a great variety of food, and in 500 stomachs of the common toad (examined in this and preceding fiscal years) no fewer than 1,200 food items were identified. This great diversity of food makes the work slow and tedious. During the year a leaflet was prepared summarizing the economic status of the common toad, with some notes on its habits, and another on poisonous snakes of the United States was manifolded and distributed.

More than 300 stomachs of mammals were examined, including chipmunks, pocket mice, rabbits, moles, shrews, bears, caribou, mountain sheep, moose, and deer. Knowledge of the food of grazing animals is of considerable value in connection with the bureau's investigations of the reindeer industry in Alaska and in determining the relation of the feeding habits of big game to live-stock grazing.

BIOLOGICAL INVESTIGATIONS.

In general, the technical work of this division has continued along lines supplying the definite basic information required for the proper discharge of the various duties of the bureau, such as the enforcement of the migratory-bird treaty and the Lacey Acts, the administration of mammal and bird reservations, the conservation of game birds and mammals, and lines bearing upon the relations of birds and mammals to agriculture, forestry, and animal husbandry. The

biological surveys of States and field operations in general have been curtailed, owing to the limited funds available. Notable additions have been made to the various information files and card indexes on the distribution, abundance, and habits of North American birds and mammals, the accumulating data yearly affording more complete knowledge of the life histories and complex relations of wild life to human welfare. These files, containing information gathered from many sources, increase steadily in value and are indispensable in conducting the work of the bureau. They are constantly being consulted to furnish information sought by other governmental departments, State officials, scientific and other institutions, and individuals throughout the United States and many foreign countries. Noteworthy advance has been made in the banding of birds as a means of obtaining exact information concerning their migrations, which is of special value in connection with the enforcement of the migratory-bird treaty act.

BIOLOGICAL SURVEYS OF STATES.

Because of limited funds, field-survey work was continued only in the State of Washington. A field party operated in the Olympic Mountains, mainly in the higher sections and on the northern slopes of this isolated mountain mass. The State College of Washington, which is cooperating with the bureau in this survey, had a representative with the party a part of the time from the first of July to the end of September. During October, November, and December, a field representative of the bureau continued work in various scattered localities, chiefly east of the Cascade Mountains, and practically completed the biological survey of the State. With the completion of field work the preparation of the final report was undertaken.

Progress was made in the preparation of faunal reports, especially on the "Mammals of Wyoming" (nearly completed) and the "Mammals of Oregon." Technical studies of mammals were continued during the year and systematic revisions of the shrews and chipmunks were well advanced.

DISTRIBUTION AND MIGRATION OF BIRDS.

Work dealing with bird migration has been carried on as in previous years, and the number of voluntary observers reporting on the subject was about 250, including some new observers from the Southern and Western States, regions from which reports are greatly desired. Considerable progress has been made in abstracting records from published sources, and the copying of the field notes of various members of the survey is now up to date. The number of record cards in the distribution and migration files is now nearly 1,500,000. Considerable work has been done on the bird collection in identifying, carding, and arranging material of recent acquisition.

BIRD COUNTS.

Reports of bird counts numbered about 55, a slight increase over those of last year, and included many made on the same areas as in previous years, which form a valuable and exceedingly important

series. The third report on bird counts in the United States, which covers the years 1916 to 1920, inclusive, was prepared for publication.

BIRD BANDING.

The bird banding work has made substantial progress during the period covered by this report. At the close of the year the cooperators enlisted in this project numbered 490, and the number is being continually augmented as the interest increases. Cooperation is being extended by various State organizations, including game commissions, colleges, and universities.

Perhaps the most noteworthy feature of the past year has been the great interest developed in the New England States, especially in Massachusetts, which resulted in the formation in January of the New England Bird Banding Association, organized for the purpose of increasing interest in bird banding and furthering the cooperation of individuals and organizations with the Biological Survey. A representative of the bureau was present at the organization meeting to arrange for the proper coordination of the activities of the new organization with the work of the bureau.

The number of birds banded under the direction of the bureau during the year was about 6,000, and much valuable information has been obtained from "return" and "repeat" records, numbering about 2,500. It is anticipated that these numbers will be greatly increased as the work develops. The work done during the year included the systematic trapping and banding of land birds, the banding of fledglings, and particularly the banding of waterfowl for the purpose of obtaining information for use in the administration of the migratory bird treaty act. Three field trips were made in the interest of bird banding work. The first, to North Dakota, in July and August, was made in cooperation with a collaborator of the bureau, and during its continuance experiments were carried on at several points in an endeavor to devise proper methods to be employed in banding waterfowl during the nesting season. The second trip, in January and February, was for the purpose of banding waterfowl near the Mississippi River in Iowa, where large numbers of ducks had congregated and remained during the winter; some work was also carried on in Missouri for the same purpose and for obtaining motion pictures of trapping and banding operations. The third trip, in February and March, was made to band waterfowl along the Illinois River near Browning, Ill., chiefly on the grounds of the Sanganois Club, in cooperation with the owners of this hunting preserve. During these trips important results were obtained in the banding of waterfowl, and the banding of these birds will be continued during the coming year. A few articles relating to bird-banding work were published through outside ornithological mediums, and two mimeographed circulars under the title "Bird banding notes" were issued to collaborators for the purpose of furnishing them information needed in carrying on the work.

INVESTIGATIONS OF MIGRATORY WILD FOWL.

Investigations of migratory wild fowl have been continued in cooperation with State game officials. Considerable information on the breeding and mating of ducks and geese in the United States and

Canada was obtained from sportsmen, naturalists, and State game officials, which will be of particular value in carrying out the provisions of the migratory-bird treaty act. All the data were carded and made available for use. Furthermore, a card catalogue of all the birds collected under scientific collecting permits was made, including the records from 1918 to 1920, inclusive, covering the years during which Federal permits of this character have been issued.

The gratifying increase in numbers of ducks reported from many parts of the country is ascribed largely to the protection accorded under the Federal regulations prohibiting spring shooting, which formerly seriously interfered with the mating and breeding of the birds. Insistent demands have been received from certain Middle Western sections, especially in Missouri, that a spring shooting season be granted extending from February 10 to March 10, which would include the height of the spring migration, the hunters asserting that as the birds are not mated no harm would be done. In order definitely to establish whether or not the birds are mated at that season in Missouri, an assistant of the bureau was sent to the State early in February with instructions to observe the birds, kill a certain number, and make examinations of their reproductive organs. By February 21 mallard ducks in numbers were constantly seen in pairs, and enlargement of the breeding organs was clearly shown by examination of two females killed March 8 and of two males killed March 9. Still more decided increase in the size of these organs in both sexes was shown by several specimens taken March 17. The evidence was clear, therefore, that mating was in progress during February and March.

A member of the staff was sent to McGregor, Iowa, in August to represent the Biological Survey at the American School of Wild Life Protection. During the session of the school considerable information was disseminated in regard to the bird-protection work of the bureau, and close cooperation was established with this school, which is rapidly becoming an important factor in wild-life protection in the Mississippi Valley.

WILD LIFE IN NATIONAL PARKS AND NATIONAL FORESTS.

In September an investigation of the conditions affecting game at that season on the Wichita National Forest and Game Preserve was made by an assistant of the bureau in cooperation with the Forest Service, with special reference to determining the carrying capacity of the range and developing a program for disposing of surplus animals, particularly buffalo and elk. A second visit was made early in March to observe winter conditions on the area.

At the suggestion of Gov. Robert D. Carey, of Wyoming, a joint investigation was made in February and March by representatives of the bureau, the State game department of Wyoming, and the Forest Service of the problem of obtaining sufficient winter forage for elk. This work was centered chiefly in the upper Wind River and Jackson Hole sections of Wyoming, and the joint recommendations made by the party will form the basis for further cooperation of Federal and State agencies in efforts to check the rapid diminution in the number of elk in this region.

An assistant of the bureau attended the Georgia Forestry Convention at Macon in June and delivered an address on the relation of forestry to wild life in the South, stressing especially the importance of controlling forest fires, which are destructive not only to forests but also to valuable wild life. On request of the department of game and fish of Georgia an examination was made in June of conditions on Blackbeard Island, where deer were alleged to have become excessively abundant under the complete protection afforded by an executive order. Adjustment of the matter was pending at the close of the year.

LIFE HABITS OF INJURIOUS ANIMALS.

Studies of the life habits of animals were continued during the year, especially the food habits of certain injurious rodents, because of the urgent need of more intimate knowledge of the relations of these animals to agriculture, forestry, and stock raising. The information thus gained is of special importance in efforts of the bureau to develop improved methods of control or eradication of rodent pests.

Field investigations of beavers were made in Washington, Minnesota, Wisconsin, Michigan, and New York. Complaints had reached the bureau from various places, especially in the Adirondack Mountains, N. Y., of extensive damage by the beaver, in response to which studies were made with a view to the control of this valuable fur bearer and its utilization in fur farming. As a result of these investigations a bulletin covering the economic status of this animal was prepared and is now in press.

In Washington and Oregon field studies of pocket gophers in progress were practically completed at the end of the year. An account of the life habits and economic relations of the so-called mountain beaver, or sewellel, based largely on work in Washington, is nearly completed. In Arizona a part of the month of October was devoted to checking results of investigations in and about experimental plots established in cooperation with the Forest Service, the Carnegie Institution of Washington, and the University of Arizona, to determine the effect of native rodents on forage production and the carrying capacity of stock ranges.

PROTECTION OF LAND FUR-BEARING ANIMALS IN ALASKA.

The work of protecting land fur-bearing animals in Alaska has been carried on so far as possible with the limited appropriation and under the inadequate fur law now in force. On September 10, 1921, new regulations for the protection of land fur-bearing animals in Alaska were promulgated, the most important change being the opening of the season on beaver and marten; there had been no open season on beaver since 1910 and none on marten since 1916. The new regulations lengthened the open season on muskrat in district No. 1 one month in spring, to April 30, and also prohibited the destruction of beaver houses or runways by the use of dynamite or other explosives or in any other manner.

Fur-warden service has been continued through the chief fur warden at Juneau and through wardens and deputies at Unalakleet,

Fairbanks, Unalaska, Akutan, and Tyonic, and in the States at Seattle and Tacoma, Wash. With the opening of the season on beaver and marten, the warden service at San Francisco was discontinued. In addition to the bureau's own force of fur wardens, excellent cooperation has been extended by the Customs Division of the Treasury Department and by agents of the Department of Justice in Alaska.

SEIZURES OF FURS.

Because of the inadequate law under which prosecutions must be made for violations of the fur law and the regulations thereunder, there have been few arrests and seizures of furs and fewer prosecutions. The use of poisons, trapping out of season, and the destruction of beaver houses are the most serious problems to contend with under the law now in operation. Unless a new Alaskan fur law is soon enacted, an acute situation will develop as to the future supply of land fur-bearing animals, one of the most valuable natural assets of the Territory.

Of nine seizures made of contraband furs, two were later released because of insufficient evidence. Furs seized included skins of 165 beavers, 96 martens, and 2 red foxes (unprime). Five convictions for illegal beaver trapping were secured, each resulting in the imposition of fines. The proceeds from the sale of seized furs during the year amounted to $3,304.43.

SHIPMENTS OF ALASKAN FURS.

Shipments of furs from Alaska covering the period from December 1, 1920, to November 30, 1921, as reported by postmasters and agents of transportation companies in Alaska, were considerably below those of the previous year—due no doubt to trappers holding their furs because of the prevailing low prices. The value of the land furs shipped, exclusive of pelts of blue and white foxes from the Pribilof Islands (under the jurisdiction of the Bureau of Fisheries), amounted to $762,296.52, being $317,272.34 less than for the previous year. The number of the principal pelts shipped and their value are as follows:

Kind of fur.	Number.	Value.	Kind of fur.	Number.	Value.
Muskrat	218,737	$273,421	Beaver	236	$4,248
Blue fox	738	73,800	Otter (land)	1,174	29,350
White fox	2,108	63,240	Mink	18,091	180,910
Red fox	2,497	44,946	Marten	676	20,280
Silver-gray fox	183	32,025	Weasel (ermine)	6,786	4,071
Cross fox	371	11,130	Black bear	719	10,785

PATROL SERVICE IN SOUTHEASTERN ALASKA.

The bureau's seagoing power boat *Regal*, used in the waters of southeastern Alaska, has been rechristened *Sea Otter*. It has a heavy-duty gasoline engine, and as it is one of the best of the patrol boats in those waters it will make it possible for the chief fur warden to visit the entire coast line for securing better observance of the law and investigating the fur farms on many islands to help establish this growing industry on a sound basis.

FUR FARMING IN ALASKA.

All but 2 of the 10 islands off the southern coast of Alaska under the supervision of the bureau are under lease for fur farming. The lease on Chowiet Island was canceled at the request of the lessee, and no favorable consideration has been given to applicants for Simeonof Island, as it is already occupied by natives and others.

Reports received from the lessees of the eight other islands indicate that nearly all are meeting with varying degrees of success. Blue foxes continue to be the chief animals farmed on practically all islands, although a few fur farmers experimenting with black foxes apparently are meeting with success, and a few small attempts are being made to farm martens. Fur farming in Alaska is still mainly confined to the southern and southeastern coast and adjacent islands.

For the purpose of securing definite information regarding the condition of the fur-farming industry with a view to helping build it up, the chief fur warden, accompanied by the bureau's fox-farming expert, has been making a reconnaissance along the southern coast with the power boat *Sea Otter*, gathering information to serve as the basis for a publication on fur farming in the Territory. Through cooperation with the Forest Service, which issues permits for fur farming on islands within the Tongass and Chugach National Forests, arrangements are being made for meetings of fur farmers in the Territory during the fall of 1922 for the purpose of conference and organization.

Fox farming is increasing in the Aleutian Chain, where permits for the use of suitable islands are still being issued free to natives and at a nominal charge to others. Seventeen permits were issued for islands in this chain during the year, making a total of 56 now in effect. Several permits for islands were canceled on recommendation of the bureau's representative at Unalaska, some permittees having died and others having failed to make use of their permits or having attempted to transfer them without approval. The natives are encouraged to use all suitable islands for the propagation of foxes.

A bill now pending in Congress, if enacted, will authorize the Secretary of Agriculture to lease all islands or other unoccupied Government lands lying outside of Government reservations in Alaska or issue permits for grazing or fur farming on them. Fur farming in the Territory is already becoming an important industry and can be made still more profitable by suitable legislation for the protection of those engaged in it.

The experiment of propagating martens in the Territory has not yet met with much success. Only one of the nine individuals holding permits reports progress. Several have discontinued their attempts, and it is probable that the successful propagation of these animals will be slow in developing. Discovery of the mating season of martens at the experimental fur farm in New York should be helpful in this connection.

THE ALASKAN REINDEER INDUSTRY.

Satisfactory progress is being made in the reindeer work begun by the bureau in July, 1920. As a result of the investigations already made by the scientific staff stationed at Unalakleet (where the experiment station was first located), the manuscript for a department

bulletin on "Reindeer in Alaska," fully illustrated and containing information on practically every phase of the reindeer industry, was prepared during the year. This will be the first report of its kind ever published and should be of much practical use to those now in the reindeer business, as well as to those contemplating engaging in it.

The coming year should show still greater progress and development of practical results from the reindeer investigations. Experiments along the lines of feeding and handling will be conducted to learn the practicability of using reindeer as draft animals through the use of a more substantial diet than reindeer moss and other native forage, which they now must seek after a day of hard work.

GRAZING ALLOTMENTS.

The urgent need for expert study of the Alaskan reindeer and their herd management, to encourage the development of the business of raising these animals as a successful industry, is fully appreciated by the white herd owners, and they are showing keen interest in the work being done by the Biological Survey. Only about one-third of the reindeer are owned by whites, and the remainder mainly by the Eskimos. Now that the preliminary study of diseases and parasites and their control is completed, the working out of grazing-allotment areas is of immediate importance, and this is being done by three grazing experts with the use of an auxiliary power schooner belonging to the bureau. Among other investigations bureau experts are making quadrat studies of forage production and of the renewal of reindeer moss under varying conditions up to seriously overgrazed areas. A bill authorizing the Secretary of Agriculture to issue grazing permits has been introduced in the Senate, and the authority it contains is vitally needed for the development of the reindeer industry in the Territory.

HERD MANAGEMENT.

Demonstrations of improved methods of handling herds and individual animals have been given at various places, and in a number of instances these have been followed by the herd owners with acknowledged benefit. Such practical field demonstrations will be needed over a great area in order to impress the minds of both Eskimo and white owners. The industry is new, and crude methods of herd management are still almost universal.

REINDEER FROM NORWAY.

In March 60 reindeer arrived at the Government quarantine station at Athenia, N. J.—40 females and 20 males—which the Department of Conservation of Michigan had imported from Norway to be turned loose in the northern part of the Lower Peninsula of Michigan. An inspection of these animals by the bureau's chief reindeer expert from Alaska disclosed the fact that the Norway reindeer were much smaller than the average Alaskan animal, and also that their color was much paler. The experiment of the Michigan authorities will be watched with interest, because of the differing character of the snowfall and forage in the new habitat, particularly in view of the relative scarcity of the lichens and other food similar to that on which the animals were accustomed to feed.

In order to obtain more information regarding methods of reindeer management, Dr. Seymour Hadwen, who was the chief reindeer specialist for two years in Alaska, will go to northern Europe during the summer of 1922 to study the industry there, including herd management, prevalent parasites and diseases and their control, and such other matters as will be helpful to the bureau and to herd owners in Alaska.

LARGE CARIBOU BULLS FOR BREEDING PURPOSES.

A field naturalist with headquarters at Fairbanks has continued investigations of the caribou of that region, and much valuable information has resulted. A supply of the large type of caribou from which young bulls may be obtained for use in breeding experiments to increase the size and vitality of the reindeer has been located in the Mount McKinley National Park. With the cooperation of the National Park Service arrangements are being made to capture some of these animals and hold them in an inclosure in the park until they can be taken down the Yukon on a barge and placed with a herd of reindeer from which the reindeer bucks will be eliminated. It is believed that the meat output of the Alaskan reindeer can be practically doubled by careful selection of breeding stock.

GAME AND BIRD RESERVATIONS.

Federal game and bird reservations now number 69, all but one of which are bird refuges, and this one is also a national park, so that birds are protected there under park regulations. Five of the number are big-game refuges.

The plan of temporarily transferring wardens from one reservation to another in order to broaden their experience and usefulness has been successful. It is now contemplated filling the assistant warden vacancies as they occur with young men of proper fitness to develop into wardens, thus enabling them to grow up in the service. The practice of transferring these assistants to different reservations and of detailing them for a short time to the central office at Washington will fit them for a more effective performance of their duties and provide a well-trained personnel competent to develop the reservations along the lines of greatest usefulness.

Owing to a general need for information in reference to existing State and Federal game and bird refuges in the United States, a list of each group was prepared and issued in mimeographed form. Because of insufficient information, the lists are not absolutely complete as to the number of refuges and their acreage, but revised editions will be issued as additional data are received.

Of the 423 State game and bird refuges listed, 346 contain a total of 19,331,593 acres. Wyoming has the greatest acreage of State game and bird refuges, 4,201,200 acres in 13 units; Minnesota comes next with 2,750,936 acres in 64 units; California has 1,792,000 acres in 28 units; and Montana 1,503,429 acres in 12 units.

The list of Federal game and bird refuges gives a total of 115. The 84 for which the acreage is given have a total of 10,323,904 acres.

The great area included in Federal and State game and bird refuges indicates how general is the interest in the protection of game

and birds. These refuges are scattered throughout the country and in Alaska, Porto Rico, and the Hawaiian Islands, and few States are without them. The States lacking refuges of this kind are Mississippi, Nevada, New Hampshire, South Carolina, and West Virginia.

BIG-GAME PRESERVES.

Most of the big-game animals have increased, but serious losses were suffered in the antelope herds on the Montana Bison Range and the Wind Cave Game Preserve, S. Dak., and in the elk in Jackson Hole, Wyo. The year was marked by appalling losses of antelope, and it will take years of painstaking effort to bring these herds back to their former numbers. On the Bison Range the antelope were killed mainly by coyotes, which ran them into deep snowdrifts, where they became practically helpless. At Wind Cave large bobcats appeared to be the chief offenders, trailing the antelope in the snow and apparently killing full-grown bucks without difficulty.

This experience with predatory animals at the Bison Range and Wind Cave, combined with the severe weather conditions, indicates forcibly the difficulty attendant on developing antelope herds under fence. Their former freedom to range widely was a strong element in their favor. Under fence they appear to be the most helpless of our large game. As game preserves are developed they will naturally attract predatory animals from a wide adjacent region, especially during severe seasons when food becomes scarce. Unsatisfactory conditions caused by the drifting snows which fill the gullies and depressions raise the question of whether locations like the Wind Cave Preserve and the National Bison Range are well suited to building up antelope herds. Areas subject to a lighter snowfall, even though the same temperatures and high winds prevail, may prove better suited to these animals. A milder climate or lighter snowfall may be needed to insure success. Efforts are being continued to establish a large antelope range in the southwestern part of Idaho.

The following table shows the number of big-game animals under fence on the preserves at the close of each calendar year from 1916 to 1921; the figures for 1922 are as reported on June 30, and, except for the buffalo, are approximations:

Kind of game.	1916	1917	1918	1919	1920	1921	1922
Buffalo	206	251	311	381	431	508	594
Elk	165	205	261	345	433	519	578
Antelope	47	57	55	54	65	91	45
Deer, mule	2	2	15	21	27	54	52
Deer, white-tailed	3	6	8	9	5	21	31
Mountain sheep							16
Total	423	521	650	810	961	1,193	1,316

Two educational motion-picture films have been prepared during the year to illustrate the work of this division. One, entitled "Anne's aigrette," showing interesting pictures of the American egrets, snowy herons, and other birds on the Walker Lake Bird Reservation, Ark., is designed to demonstrate the inhumanity of the traffic in the

plumage of these birds for the purpose of personal adornment. The other film shows views of the birds on the bird-refuge islands near the mouth of the Mississippi in the Gulf of Mexico and is entitled "National bird refuges."

Detailed histories of the Bison Range and Wind Cave Preserve have been completed, a rough draft of a history of the Niobrara Reservation, Nebr., has been made, and data assembled for the writing of histories of other refuges.

National Bison Range, Mont.—With the exception of the deplorable loss of antelope during the past winter, the animals and birds have done well on this preserve, although in spring the animals were much reduced in flesh, owing to the exceptionally severe winter. Eight buffalo died during the year and 77 were born, increasing the number to 452. All deaths in the herd within the past year have apparently been from natural causes, as there has been no contagious sickness of any kind. The elk now number 325 as against 265 last year.

The unfortunate loss of antelope reduced the herd from 60 (the number reported on June 30, 1921) to 17. During the time when the range was covered with snow coyotes drove the antelope into drifts, from which they could not escape, and killed by far the larger part of the herd, an unprecedented loss. On June 30, 1922, it was estimated that 25 antelope were on the range, counting a few young of the year. Since January 1, 30 coyotes have been trapped, shot, or poisoned on this preserve or near its boundary, and 76 others were taken in the surrounding country.

In the autumn of 1921, 17 white-tailed deer and 17 mule deer were received at the range, the gift of Frank Conley, of Deer Lodge, Mont. The estimated number of mule deer now on the range is 50; and of white-tailed deer, 25.

Through the courtesy of the Canadian National Parks Service, 12 mountain sheep were obtained in February from Banff, Alberta. The band consisted of four rams and eight ewes, which were kept in a corral near the warden's quarters on the range during the remainder of the winter. They are doing well and have increased in number to 16.

The 24 ring-necked pheasants turned out in the fiscal year 1921 had increased to about 124, and at the present time 100 are reported on the range. The introduction of the pheasants has been so successful that the State has contributed this year nine pairs of European partridges, and it will be interesting to note the result; they now number 25.

Two reservoirs for watering places for the animals have been completed, one on the west side of the range and the other near the southeast corner.

Wind Cave National Game Preserve, S. Dak.—This year's calf crop has increased the buffalo herd from 71 to 90, and the elk number 149, not including calves. During the exceptionally severe weather conditions last winter the antelope herd was reduced by bobcats and coyotes from 34 to 14. The remaining animals are in splendid condition, and on June 30 there were 6 fawns reported, making a total of 20 antelope in that herd. Since January 1, 75 predatory animals were caught on Wind Cave Preserve and in the surrounding country.

A light motor truck has been obtained for use at this preserve and is a valuable addition to the equipment, as it will be very useful for fire fighting and for facilitating fence repairs, road work, and other necessary activities.

Concrete work at one of the watering places for the animals was completed during the fiscal year and has made it possible for the spring to be used more extensively and at all seasons.

Niobrara Reservation, Nebr.—There are now 41 buffalo, 54 elk, and 1 deer, as against 37 buffalo, 53 elk, and 1 deer a year ago. It is hoped that new blood can be introduced into the elk herd next year. The inspector has been instructed to arrange for the transfer of some of the excess elk from Sullys Hill to Niobrara and at the same time to weed out some of the older or less desirable animals now on this reservation.

The new game fence, 12 miles in length, is still under construction. Posts are set and a contract has been let for erecting the wire for a distance of 822 rods. When this fence is finished it will inclose approximately 4,320 acres, making this one of our best game refuges.

Sullys Hill National Game Preserve, N. Dak.—The buffalo have increased from 9 to 11, the elk from 36 to 50, and the deer from 3 to 5 during the year.

Construction work on the hostess house and other buildings and improvements was advanced last summer, and it is hoped that the work will be entirely completed during the coming summer.

Elk Refuge, Wyo.—The winter of 1921–22 is reported to have been the severest on record in relation to the elk. Extreme weather conditions did not commence until after the 1st of January. Heavy thaws followed early snows, and the resulting slush was later frozen into solid ice over the grazing lands, making it impossible for the elk to get at the native forage.

The bureau had on hand at the commencement of the winter slightly more than 1,000 tons of hay, a larger supply than ever before. In addition to this, the State furnished 200 tons. This 1,200 tons was exhausted in April, before spring conditions permitted the elk again to do their own foraging, and no funds were available to purchase more. As a result approximately 20 per cent of the total number of the elk that came to the refuge perished, not so many as in the winter of 1919–20 but probably a larger percentage of those that came to the refuge. The greatest number of elk reported on the reservation at any one time during the winter was 4,350.

There is no hay now on hand, but the outlook is good for a better crop than that of last year, which amounted to 644 tons. While it is unlikely that another extreme winter will follow that just past, still it is deemed unsafe to start the winter with so small a stock on hand, and additional hay will be purchased.

BIRD REFUGES.

There are now 68 Federal bird refuges, 4 of which are located on the big-game preserves. No new reservations have been added during the year, and one has been abandoned—the Yukon Delta Reservation, Alaska, eliminated by Executive Order No. 3642, issued February 27, 1922. The North Platte Reservation, Nebr., was slightly reduced in area by Executive Order No. 3540, dated August 26, 1921.

Twenty-seven of these reservations have warden service; of the wardens employed 9 are permanent to safeguard the reservations, 11 are part-time, and 10 are cooperative. Individual reports on all the bird refuges are not deemed necessary, but notes are given on several of the more important ones.

Big Lake, Ark.—Conditions at this reservation have continued to improve during the past year, and violations of the game laws and also of State fishing laws are less frequent. Working in cooperation with State officials, it has been very difficult for reservation wardens in the past to identify illegal fishing tackle frequently found. Recent departmental regulations requiring that all set tackle should be tagged have worked out very satisfactorily. As it is now, a man would naturally hesitate to put his identification tag on an illegal net, and untagged nets are subject to confiscation.

A survey of the boundary line has been made and the line fairly well cut and blazed, and galvanized wire is being run along its entire length. Runways have been cut through the woods, so that the wardens may quickly reach different points on the reservation and also obtain a view of places formerly hidden by brush and limbs.

During the autumn of 1921 the greatest flight of mallards since before 1918 was reported, and more Canada geese going south over Big Lake than usual, many of them stopping to feed and rest. There was also a larger number of wood ducks in the reservation and vicinity than for many years.

Lake Malheur, Oreg.—In January representatives of the Biological Survey met the governor, attorney general, State engineer, and other representatives of Oregon in Salem for the purpose of considering a compromise by which the controversy over the status of this reservation might be settled. The conference was very satisfactory, and there is a strong probability that this long-drawn controversy may be amicably concluded to the advantage of all concerned. To secure needed information representatives of the bureau and of the State visited the reservation in June, and a definite plan of action will be proposed in the near future. Because of unprecedented winter weather conditions at this reservation, it became necessary for the warden to feed grain to the birds, as they were threatened with starvation.

Tortugas Keys, Fla.—Through the courtesy of the Navy Department the warden's house on this reservation, which was completely undermined by the cutting away of the shore and in danger of falling into the sea, has been moved to the opposite or eastern side of the key and substantially set up on new piling. The key is developing considerable vegetation, which is of much importance to certain nesting birds.

Belle Fourche, S. Dak.—The effect of continuous grazing over the lands immediately adjoining the lake shore has raised the question as to whether the lack of nesting birds is not due to this destruction of growth which might form shelter for them. To settle this question definitely it has been planned to fence off a portion of the area known as the peninsula, and the fence has been partly constructed. This will be completed as soon as possible, and with the cooperation of the Reclamation Service the live stock eliminated from the area.

North Platte, Nebr.—The two smaller of the four reservoirs (No. 2 and Winter Creek) composing this reservation are very promis-

ing places for wild fowl. Unfortunately, the ponds are small, but as the rise and fall of the water does not vary more than about 2 feet they should lend themselves admirably to the planting of wild duck foods. At one of these ponds tules and some small willows and cottonwoods are already in evidence along a part of one side. The surroundings of both reservoirs are marshy.

Mosquito Inlet, Fla.—A petition has been received from the residents in the vicinity of Holly Hill, Fla., for the extension of this reservation. This shows very clearly a gratifying change of sentiment on the part of local residents toward bird protection, as at the time the refuge was created local opposition was voiced against the inclusion of any additional area.

Tampa Bay Group, Fla. (Passage Key, Indian Key, and Palma Sola).—Bush Key, which was included in the enlargement of the Indian Key Reservation, is reported to have its usual colony of roseate spoonbills, 143 having been counted by the inspector in June and a considerably greater number being reported to occur there. Passage Key was seriously damaged by a hurricane in October, and was reported to have been entirely washed away. Either this report was not strictly correct or else the sand rapidly built up again, for in January, 1922, a considerable part remained above water. The mangroves, however, had been washed away in June, 1922, and the inspector found only a small bit of the key above water, and that appeared to be washing away from the north side. It was covered with pelicans, gulls, terns, and skimmers, but no birds were nesting.

Carlsbad and Rio Grande, N. Mex., and Salt River, Ariz., are all reclamation projects, and while practically no ducks nest on them, they serve during migration and in winter as resting places for wild fowl which would otherwise be forced to go beyond the border. Many blue herons and cormorants nest on the Salt River Reservation.

MIGRATORY-BIRD TREATY AND LACEY ACTS.

The administration of the migratory-bird treaty and Lacey Acts has been seriously embarrassed by insufficient funds for maintaining an adequate warden service. Violations of the law will continue to increase until wardens can be maintained in every State. As against this disquieting situation, it is very encouraging to have reports from practically every section of the United States showing that the protection now given migratory birds is resulting in a material increase in their numbers. It has been most gratifying to observe, since the abolition of spring shooting, that waterfowl in ever-increasing numbers are extending their breeding range, convincing proof of the wisdom of the advocates of Federal protection for migratory birds.

Waterfowl have, in fact, increased to such an extent that the matter of maintaining adequate breeding, resting, and feeding places is becoming a serious problem. Reliable information is at hand from Oregon that large numbers of wild ducks died of starvation and others were in an emaciated condition after having eaten all the vegetation from the ponds in the locality in which they were found. This emphasizes the necessity for prompt and vigorous action in setting aside and perpetuating as homes for the birds and other wild life marsh and water areas unsuitable for agriculture, or less valuable for agricultural uses than they are in their natural state.

EARLY MATING OF MIGRATORY WILD FOWL IN MISSOURI.

Early in February, 1922, the bureau assigned an assistant biologist to investigate mating and breeding habits of wild fowl in Missouri, where it has been contended by a few persons, still persisting in their demands for spring shooting, that wild ducks are not mated before March 10 and do not breed in the State. Data gathered by this biologist, as previously mentioned, furnish incontrovertible proof justifying the attitude of the bureau in opposing the granting of any wild-fowl shooting privileges later in winter than January 31.

COOPERATION.

Cordial cooperation extended by State game officials and sportsmen from practically every State has contributed in a large measure toward the results achieved, not only in the enforcement of the law but in creating favorable public opinion toward its observance. Without this cooperation the bureau, with its slender force of wardens, would have been desperately handicapped.

WARDEN SERVICE.

During the year the number of United States game wardens varied from 25 to 28. They were aided by 48 United States deputy game wardens, receiving a salary when employed during short intervals in emergencies, and by approximately 350 United States deputy game wardens stationed at suitable points throughout the country, who receive a nominal salary of $1 per annum and cooperate by reporting violations, thus bringing about better observance of the law.

Violations have been numerous and appear to have increased in large sections of the country where there are no Federal wardens. It became necessary in many instances to transfer wardens from remote sections for temporary duty to localities where especially flagrant outbreaks of violations were occurring. These special assignments were salutary, but to get effective results it has been found essential to have regular employees at all times in important wild-fowl sections.

Data gathered by the bureau show that over 4,000,000 State hunting licenses were issued during the year, but this does not represent the total number of hunters, since in many States farmers and others in certain instances are exempted from the operation of hunting-license laws. With the entire United States to patrol and with such a large number of hunters in the field, it is evident that the services of a substantial force of game wardens are required if the law is to be effectively enforced and desired results are to be achieved.

MIGRATORY-BIRD TREATY-ACT ADVISORY BOARD.

The annual meeting of the Migratory-Bird Treaty-Act Advisory Board was held in Washington on December 15, with nearly all members present. Certain amendments of the Federal regulations suggested by the bureau and concurred in by the board were adopted by the Secretary and became effective on March 8, 1922, upon approval by the President. These amendments were as follows: The open season for waterfowl in New Mexico was changed from the period October

16 to January 31 to the period October 1 to January 15; the open season for mourning doves in Mississippi and Louisiana was changed from the period October 16 to January 31 to the period September 16 to December 31; and the season for mourning doves in North Carolina and South Carolina was changed from October 16 to January 31 to extend from September 1 to December 15.

VIOLATIONS OF THE MIGRATORY-BIRD TREATY ACT.

On July 1 there were 772 migratory-bird treaty-act cases pending. Of these, 194 were disposed of during the year by convictions, 60 were nolle prossed, in 36 grand juries did not return true bills, 54 were dismissed, and 2 were terminated by death of the accused. Fourteen cases tried before a jury resulted in verdicts of not guilty and 412 cases are still pending. During the fiscal year 742 new cases were reported for prosecution; of these, 349 convictions have been obtained to date, 39 have been nolle prossed, in 4 grand juries did not return true bills, 35 were dismissed, and in 5 the jury returned a verdict of not guilty. Fines and costs collected amounted to slightly over $9,800 and ranged from $1 to $250 each, and many of the defendants were also required to pay the costs, which in many instances equaled, and in others exceeded, the amount of the fine. About 200 other cases were reported by Federal wardens which for various reasons were not forwarded for Federal prosecution, but the evidence in many of them was transmitted to State game authorities for appropriate action, as infractions of State laws were involved.

The convictions in Federal courts were distributed as follows: Alabama, 27; Arkansas, 35; California, 2; Connecticut, 2; Delaware, 3; Florida, 11; Georgia, 59; Idaho, 5; Illinois, 38; Indiana, 11; Iowa, 9; Kansas, 6; Kentucky, 7; Louisiana, 7; Maine, 6; Maryland, 28; Massachusetts, 29; Michigan, 4; Minnesota, 12; Mississippi, 13; Missouri, 20; Montana, 2; Nebraska, 8; New Hampshire, 1; New Jersey, 13; New Mexico, 1; New York, 3; North Carolina, 4; Ohio, 7; Oklahoma, 1; Oregon, 8; Pennsylvania, 6; Rhode Island, 3; South Carolina, 1; South Dakota, 8; Tennessee, 54; Texas, 38; Virginia, 23; Washington, 18; Wisconsin, 10.

Many substantial penalties were imposed against violators, although some offenders escaped with small fines or merely on the payment of costs. Among the penalties imposed were 10 jail sentences ranging from 5 days to 4 months, in Arkansas, Florida, Illinois, Maryland, South Carolina, and Virginia, and fines ranging as high as $250; and a number of the violators were given both fines and jail sentences. The character of violations included trapping and selling wild ducks, illegal shipment of ducks for sale, killing wild ducks in close season, killing great blue herons, hunting ducks after sunset, hunting waterfowl from a sailboat, and offering to sell wild ducks. Many other fines ranging from $25 to $100 were also imposed against offenders for offering to sell and selling aigrettes, possessing ducks in storage during the close season, and for other miscellaneous offenses. The third conviction for the hunting of wild fowl from an airplane was obtained in the Federal court at Trenton, N. J., on February 12, where the violator charged with killing a goose from an airplane was fined $25.

An extended drive against persons killing mourning doves during the close season was made in several of the Southern States and

resulted in the apprehension of 160 violators. Of this number 118 have been prosecuted and fines ranging from $5 to $20 imposed, as follows: Alabama, 17; Georgia, 49; Mississippi, 20; and Tennessee, 32. The remaining cases are still pending.

The mourning, Carolina, or turtle dove, is a migratory bird coming within the protection afforded by the migratory-bird treaty and the act of Congress to give it effect, even though individuals of the species remain within the borders of certain States the entire year, according to a decision rendered in the case of United States against Joseph H. Lumpkin, brought to trial at Athens, Ga., November 14, 1921, before Federal Judge S. H. Sibley and a jury. The defendant, who was charged with killing mourning doves during the Federal close season, contended that the birds which he had killed had not migrated, but had remained in Georgia the entire year, and for this reason were not covered by the Federal statute. The court held as a matter of law that the mourning dove is protected by the migratory bird treaty act and regulations and instructed the jury that the only question of fact to be decided by it was whether the defendant actually killed mourning doves in the close season as charged in the indictment. The trial, which consumed two days and attracted widespread attention, resulted in a verdict of guilty and the imposition of a fine of $25 and costs.

A large number of seizures were made of migratory game birds illegally killed or possessed, and most of these were disposed of by the bureau, with consent of the accused, by gift to hospitals or charitable institutions for use as food. Contraband plumes and mounted specimens of migratory birds of an estimated value of $2,000 were seized during the year. Many of these specimens were formally released to the bureau to be used for scientific and educational purposes.

Many violations of State game laws were observed during the year by Federal wardens, who transmitted the evidence in regard thereto to proper State game officials for prosecution, and information received to date shows that 94 such cases have been successfully prosecuted, netting fines totaling $3,436.

The wardens also conducted an educational campaign to enlighten the public concerning the provisions of the Federal game laws and their objects and purposes. In three instances wardens were assaulted by violators while attempting to perform their duties, and in one case the warden was overpowered by three violators and relieved of his pistol and badge.

PERMITS.

During the year, 952 permits were issued authorizing the collecting of migratory birds, nests, and eggs for scientific purposes. More than half of these were limited permits, confining operations to the collection of nongame birds and of shorebirds during the open season for black-breasted and golden plovers and greater and lesser yellowlegs. The issuance of these limited permits was authorized by an amendment of regulation 9 of the migratory-bird treaty act regulations adopted March 3, 1921. Reports from the permittees show that approximately one-third of them collected no birds, nests, or eggs whatsoever during the year. A large number of others col-

lected less than five birds each and no nests or eggs. Permits authorizing the possession, purchase, sale, and transportation, but not the collection, of migratory birds lawfully taken for scientific purposes were issued to 185 persons; permits of this nature are issued usually to taxidermists or others to whom it appears undesirable to give the privilege of collecting specimens.

Permits authorizing the possession and sale of migratory waterfowl raised in captivity were issued to 4,765 persons, and permits authorizing the taking of a limited number of waterfowl or their eggs for propagating purposes were issued to 87.

In its quest for information relative to the times and lines of flight of migratory birds, the bureau issued permits authorizing the trapping of migratory birds alive for banding purposes to 490 persons. The holder of a bird-banding permit is allowed to possess a migratory bird only a sufficient length of time for it to be properly banded and liberated.

INTERSTATE COMMERCE IN GAME.

Ten new cases involving violations of the Lacey Act were reported to the Solicitor for prosecution during the year. This reduction in the number of cases from that of previous years is no doubt occasioned by the fact that shipments of birds, which were formerly covered by the Lacey Act, now come under the migratory-bird treaty act. Thirty-two cases were disposed of in court, 4 of which were dismissed and 1 nolle prossed; the total fines collected in the remaining 27 cases amounted to $931.10. One hundred and fifteen investigations were closed for various reasons, a sufficient amount of evidence not being secured to warrant prosecution, the shipments being found to be legal, the offense having occurred so long ago that it had expired under the statute of limitations, or the nature of the offense not warranting prosecution. Two hundred and twenty-two cases were turned over to State officials for prosecution under State laws, 118 of which have already resulted in convictions netting the States a total in fines and costs of approximately $5,000. At the present time investigations are pending in the bureau in approximately 150 cases. The enforcement of the Lacey Act has been particularly effective in suppressing traffic in beaver skins illegally taken.

IMPORTATION OF FOREIGN BIRDS AND MAMMALS.

Following the war period of depression, the importation of birds and mammals from foreign countries is gradually returning to normal. Although the 528 permits issued were 32 less than in 1921, the number of individuals and species was greater and the number of shipments inspected increased from 155 to 186.

Canaries were imported in increased numbers, and the trade in parrots with Mexico, South America, and Australia is being revived. Traffic in game birds is increasing more slowly and is confined chiefly to Mexican quail and Hungarian partridges. At Honolulu, Hawaii, additional permits were issued for the entry of miscellaneous birds, chiefly pigeons, quail, and ducks. Altogether there were entered under permit 154,547 canaries, 37,953 Mexican quail, and various other miscellaneous birds, making a total of 313,623, of which 274,997 were inspected. In addition, there were entered at the ports of New

York, San Francisco, and other ports, chiefly as passengers' baggage without requirement of permit, 9,075 parrots and parrakeets, 4,627 canaries, and 10,352 miscellaneous birds. These latter included many parrots brought in at the ports of Brownsville and Laredo, Tex., without permits when not accompanied by other birds. The total number of birds imported during the year was 337,677.

Permits for mammals included 2,064 foxes from Canada. A considerable number of these permits were not used and others covered the entry of animals brought in for exhibition purposes and later returned. The number of foxes actually remaining in the country, therefore, was probably less than that stated. During the year many foxes were admitted to entry without quarantine under inspection by official veterinarians of the Canadian Government. In view of the examination of the animals by Canadian authorities prior to shipment, the requirements of quarantine at the border seemed unnecessary, and this regulation was rescinded on October 15.

The year has been notable for the number of elephants brought in for menageries and zoological gardens. Among other noteworthy mammals was a duckbill (*Ornithorhynchus anatinus*) from Australia, the first ever brought alive to the United States. This interesting animal reached San Francisco late in June and was exhibited in the New York Zoological Park for about two months previous to its death, the last of August, 1922. Shipments from Australia also included several species of kangaroos and other marsupials, rarely, if ever, imported before, such as the Parry wallaby (*Osphranter parryi*), the striped wallaby (*Petrogale lateralis*), and the vulpine phalanger (*Phalangista vulpina*).

The importation of birds for cage-bird traffic, restocking game covers, and exhibition in zoological parks has shown a marked increase. The number of canaries imported last winter for the Christmas trade, though smaller than in years prior to the war, was more nearly normal than for some seasons past. Traffic in parrots has also shown some development. A few large shipments of Cuban parrots have been received at New York, and several extensive shipments of parrots and parrakeets have been made from Australia. In one instance no less than 6,000 Australian love birds, or shell parrakeets (*Melopsittacus undulatus*), were received in a single consignment. Game birds for restocking covers have been confined chiefly to Mexican quail and Hungarian partridges. The importation of the latter species has been resumed for the first time since 1915, and two large shipments were received in the spring, one of which included 1,000 birds for the State of Montana. The Hungarian partridge has done well in the Northwest, particularly in eastern Washington, northeastern Oregon, and the Province of Alberta. The success which has attended experiments in introducing this species in that region has led to many inquiries and a renewed interest in the importation and distribution of the birds.

Pheasants have shown no appreciable return to normal so far as entries are concerned. Since the war most of the traffic in pheasants for propagation has been confined to those raised in the United States, either on State or on private game farms, and the large number formerly imported from England and Canada has diminished to small proportions. The importation of birds for exhibition purposes from Europe and Australia has shown an unusual variety, and

many rare species not often brought in have been received during the year. On the other hand, a few birds formerly common, as the rhea, or South American ostrich, have fallen off to such an extent that an entry is a noteworthy event, only two or three shipments containing rheas being received during the year.

An unusual number of interesting birds arrived from South America and from Australia and the neighboring islands. Among these may be mentioned 9 pileated herons (*Pilherodius pileatus*) from Colombia, a black guan (*Aburria aburri*) from Venezuela, a Cassin macaw (*Ara auricollis*) and a Weddell parrakeet (*Eupsittula weddelli*) from Bolivia, a number of kagus (*Rhinochetus jubatus*) from New Caledonia, 25 Philippine pectoral rails (*Hypotaenidia philippinensis*), 55 New Guinea pink-headed pigeons (*Ptilopus superbus*), a Ducorps cockatoo (*Cacatua ducorpsi*) from the Solomon Islands, and a number of Australian species, as the semipalmated goose (*Anseranas semipalmata*), the regent bower bird (*Sericulus melinus*), the Morton Bay rosella parrot (*Platycercus pallidiceps*), the Bourke parrakeet (*Neophema bourkei*), the gold and green lory (*Psitteuteles chlorolepidotus*), the Princess Alexandra parrakeet (*Polytelis alexandrae*), and a large number of other parrots, cockatoos, and love birds.

IMPORTATIONS OF QUAIL FROM MEXICO.

Through the cooperation of the Bureau of Animal Industry inspection of quail from Mexico was provided, as heretofore, at Brownsville, Laredo, and Eagle Pass, Tex., from November 1 to April 20. Quarantine of birds, however, was not required if the shipments showed no evidence of quail disease. Few birds arrived until the latter part of January. The total number of quail entered during the season was 37,953, the largest number ever entered in any one year. At Brownsville 9,773 birds were entered; at Laredo, 15,408; and at Eagle Pass, 12,772. Quail disease appeared at Laredo about February 23, and 500 birds were placed in quarantine, but with this exception few losses due to the disease occurred. On the whole the season was one of the most successful in recent years. Most of the quail imported were shipped to the State game authorities of Kentucky, Maryland, and Pennsylvania and were distributed for propagating purposes; Kentucky received 6,600 and Maryland 10,317. The Maryland consignments, comprising nearly a third of the total number imported, suffered a loss of less than 1 per cent through deaths en route.

The number of quail received from Mexico during the 12 years since importation began has now reached a total of 152,348. Many of the birds this season were sold at prices ranging from $18 to $24 or more a dozen, which would make the cost to purchasers of the importations this year between $55,000 and $75,000.

PUBLICATION AND INFORMATIONAL WORK.

During the year 24 publications of the department prepared in the Biological Survey were issued, including 5 revisions of earlier bulletins; and at the close of the year 11 manuscripts, including 3 revisions, were in press or had been submitted to the Assistant Secretary for publication, and 4 new manuscripts prepared during the

year, including 1 revision, were ready for editing preliminary to publication.

Publications issued during the year were as follows: Annual Report of Chief of Bureau for 1921; Department Bulletin No. 1049, Game as a National Resource; North American Fauna No. 45, A Biological Survey of Alabama: Part I, Physiography and Life Zones; Part II, The Mammals; Farmers' Bulletins No. 1235, Game Laws for 1921; No. 1238, Laws Relating to Fur-Bearing Animals, 1921; No. 1239, Community Bird Refuges (including one revised edition); and No. 1247, American Moles as Agricultural Pests and as Fur Producers; Department Circulars No. 196, Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1921; and No. 225, Annual Report of the Governor of Alaska on the Alaska Game Law, 1921; Separates from the 1920 Yearbook: No. 836, Conserving Our Wild Animals and Birds; No. 843, Farm Help from the Birds; No. 845, Hunting Down the Stock Killers; and No. 855, Death to the Rodents; Service and Regulatory Announcements Nos. 42 to 46 (B. S.), containing the text of regulations and orders affecting bird reservations and land fur-bearing animals in Alaska; Poster No. 41 (Bi.), Open Seasons for Game, 1922; and revisions of the following: Department Bulletin No. 793, Lead Poisoning in Waterfowl; and Farmers' Bulletins No. 525, Raising Guinea Pigs; No. 621, How to Attract Birds in the Northeastern United States; No. 912, How to Attract Birds in the East Central States; and No. 1239, Community Bird Refuges, above mentioned.

Manuscripts in press or submitted to the Assistant Secretary and not published at the close of the year were as follows: Department bulletins No. 1078, Beaver Habits, Beaver Control, and Possibilities in Beaver Farming; No. 1089, Reindeer in Alaska; and No. 1091, Life History of the Kangaroo Rat, *Dipodomys spectabilis spectabilis* Merriam; North American Fauna, No. 46, A Biological Survey of Alabama: Part III, The Birds; No. 47, A Biological Survey of North Dakota: Part I, Physiography and Life Zones, Part II, The Mammals; No. 48, A Biological Survey of the Pribilof Islands, Alaska: Part I, Birds and Mammals, Part II, Insects, Arachnids, and Chilopods; No. 49, Mammals of New Mexico; Farmers' Bulletin No. 1288, Game Laws for 1922; and revisions of the following farmers' bulletins: No. 506, Food of Some Well-known Birds of Forest, Farm, and Garden; No. 702, Cottontail Rabbits in Relation to Trees and Farm Crops; and No. 844, How to Attract Birds in the Middle Atlantic States.

Manuscripts completed during the year but not yet submitted for publication were as follows: A department bulletin on "The marsh and aquatic plants of Missouri as wild-duck foods"; a department circular on "Experiments in the use of carbon tetrachlorid as an anthelmintic for foxes"; a farmers' bulletin on "How to get rid of rats"; and a revised farmers' bulletin (No. 770) on "Canaries: Their care and management."

In addition, many items for the press and articles for outside scientific periodicals have been prepared or authorized, and numerous photographs have been selected from official negatives for the press and for individual writers.

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